AD
TECH REPORT 68-9
DEC 1968

TECHNICAL REPORT

AD681922

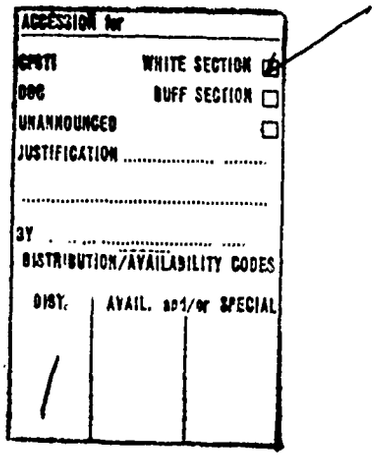
HELMET COST STUDY

GORDON A. FINCH
FRANK C. SCHROEDER, III

DDC
FEB 6 1969
C

SYSTEMS AND COST ANALYSIS DIVISION
COMPTROLLER AND DIRECTOR OF PROGRAMS
U.S. ARMY MATERIEL COMMAND
WASHINGTON, D.C., 20315

This document has been approved for public release and sale; its distribution is unlimited.



DISPOSITION

DESTROY THIS REPORT WHEN NO LONGER NEEDED.

DO NOT RETURN IT TO THE ORIGINATOR.

DISCLAIMER

THE FINDINGS IN THIS REPORT ARE NOT TO BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION

Technical Report 68-9

Helmet Cost Study

GORDON A. FINCH
US Army Materiel Command

FRANK C. SCHROEDER, III
US Army Materiel Command

December 1968

The views of the authors do not purport to reflect the position of the Department of the Army or the Department of Defense.

Systems and Cost Analysis Division
Comptroller and Director of Programs
US Army Materiel Command
Washington, D.C. 20315

TABLE OF CONTENTS

		Page
	Abstract	i
	List of Figures and Tables	ii
I.	Introduction	1
II.	Titanium - Type I	4
III.	Titanium - Type III	10
IV.	LINCLOE Nylon	14
V.	Hayes-Stewart Helmet	20
VI.	Learning Curve Information	26
VII.	General Summary	27
VIII.	Summary Worksheet	29

Abstract

This study provides life cycle cost data on these US Army infantry-type helmets: (1) Titanium Type I; (2) Titanium Type III; (3) LINCLOE nylon; and (4) Hayes-Stewart. These data include research and development, production, and operating costs. A 95 per cent learning (experience) curve gradient is appropriate for helmet production.

LIST OF FIGURES AND TABLES

Figure 1. Standard Helmet Configuration

Table 1. Titanium Type I Helmet RDT&E Costs

2. Titanium Type I Helmet Investment--Non-Recurring Costs

3. Titanium Type III Helmet Investment--Recurring Costs

4. Titanium Type I Helmet Operating Costs and Factors

5. Titanium Type III Helmet RDT&E Costs

6. Titanium Type III Helmet Investment--Non-Recurring Costs

7. Titanium Type III Helmet Investment--Recurring Costs

8. LINCLOE Nylon Helmet RDT&E Costs

9. LINCLOE Nylon Helmet Investment--Non-Recurring Costs

10. LINCLOE Nylon Helmet Investment--Recurring Costs

11. LINCLOE Nylon Helmet Operating Costs and Factors

12. Hayes-Stewart Helmet RDT&E Costs

13. Hayes-Stewart Helmet Investment--Non-Recurring Costs

14. Hayes-Stewart Helmet Investment--Recurring Costs

15. Hayes-Stewart Helmet Operating Costs and Factors

16. Life Cycle Helmet Cost Data

Figure 1

STANDARD HELMET CONFIGURATION

I. INTRODUCTION

In order to provide greater head protection to the soldier with a possible weight reduction of head gear, Department of the Army authorized the development of various helmets. Titanium and nylon are the materials currently being considered. The standard design and the Hayes-Stewart design are included in the study.

On 17 May 1968, a meeting was held at HQ, AMC, to discuss various aspects of the helmet study.

As a result of this meeting, on 24 May 1968 this division requested AMSAA to conduct a cost-effectiveness study. In conjunction with this request, AMCCP-SC is making the cost analysis and AMCCP-SS is evaluating the cost-effectiveness of this system. In addition to estimating the helmet system costs, supplementary studies of fatal and non-fatal costs are being conducted respectively by AMSAA and the Statistics and Data Base Branch of AMC.

Data Sources

Cost data for the helmet analysis were obtained from:

a. Natick Laboratories Project Officer

b. Contract costs

c. Engineering estimates (from Natick Laboratories and Industry)

d. Defense Supply Agency

e. Defense Depot at Ogden, Utah

f. Office of Material Requirements, AMC

g. Private Industry

Assumptions

The following list of assumptions provides the foundation upon which many of the estimates are built. Some of these assumptions have been made to enable this branch to complete the report within the time schedule. Other assumptions have been made to provide consistency to this paper.

1. Garrett Corporation overhead, General & Administrative, and profit percentages were used for titanium estimates because they were the only accurate figures available.
2. Fixed price contracts were assumed.
3. Set up costs for the LINCLOE nylon helmet are essentially the same as the nylon liner.
4. Set up costs for titanium helmet types I and III are basically similar except for contingent costs incurred when working with the heavier type III material.

5. Hayes-Stewart material will be 7 ply nylon.
6. M-1 steel cover and nylon liner were used as a basis of comparison for the proposed systems. The former provided the necessary cost factors.
7. All dollars are normalized in 1968 terms.
8. First destination transportation is from the contractor to a CONUS depot.
9. Second destination transportation is from a CONUS depot to troops in the field.

II. TITANIUM - TYPE I

This helmet is the lighter of the two proposed titanium systems. It is designed only as an outer shell, and would utilize the presently used nylon liner. The approximate weight of the helmet without liner is 1.5 pounds. The shape of the unit is the same as the M-1 steel helmet.

The cost are presented in a detailed breakdown of the three life cycle phases: R&D, Investment (Initial and Sustaining), and Operating and Maintenance. The following format will be used for all systems discussed in the report.

Table 1

TITANIUM TYPE I HELMET R&D COSTS

1.	Engineering	$ 6,300
2.	Tooling & Test Equipment	4,500
3.	Prototype Production	20,500
4.	Systems Test & Evaluation	4,000
5.	Data Handling & Documentation	2,500
	TOTAL	$37,800

The cost figures indicate expended funds, and were allocated under Applications Engineering Funds for product improvement. However, the funds were used in research and development of the helmet. Additional research and development would not be required to enter the Titanium Type I Helmet into production.

Table 2

TITANIUM TYPE I HELMET
INVESTMENT--NON-RECURRING COSTS

1.	Production Base Support	$ 75,000
2.	Advance Production Engineering	25,000
3.	Tooling & Test Equipment	45,000
4.	Other	12,450
	TOTAL	$157,450

The cost incurred in setting up a production base resulted solely from a $75,000 five stage, double-acting hydraulic press. The cost of $25,000 was incurred mainly by engineering labor and services for a one year period.

There were two estimates for tooling--$35,000 for the cold worked process, and $21,500 for the hot forming process. However, information was received that there are

many complications in the hot forming process not present in the cold worked process, and that these factors may well result in cost far exceeding the cost of cold working. Therefore, with a $10,000 assessment for test equipment, the total figure of $45,000 ($35,000 + $10,000) was used. Other costs included such factors as administrative and documentation, new equipment training, and inventory management effort. Based upon the higher degree of involvement of setting up this titanium production line, an estimate of 150 per cent of the similar steel production base was used ($8,300 x 1.50 = $12,450). These are the investment/non-recurring costs assuming uninterrupted production (hot base).[1]

---

[1] Interrupted production will result in storage and set up costs in the following amounts:

a. Storage and maintenance of tooling and equipment--2 assembly lines at a cost of $460/month each.

b. The cost incurred by the government to pull the line from storage, to pack the line, to ship the equipment, to install it at the contractor's facilities, and to ship the line back to an Industrial Equipment Reserve (IER) is $83,000.

These costs are currently being incurred by production lines of the M-1 steel helmet and nylon liner, and it is presummed that the same costs incurred by the LINCLOE nylon and the Hayes-Stewart helmet production lines will vary with size, space occupation, and involvement of set up/take down effort of equipment.

Table 3

TITANIUM TYPE III HELMET
INVESTMENT--RECURRING COSTS

1. Helmet	
a. Direct material	$13.60
b. Chin strap (material)	.20
c. Hinge loop assembly (material and labor)	.25
d. Manufacturing labor costs	3.47
e. Manufacturing overhead @ 180.5% of direct labor cost	6.26
f. Reject rate	.38
g. G&A @ 19.5% of total (items a-f)	4.71
h. Profit @ 12.5% of total (items a-g)	3.61
2. First Destination Transportation	.02
TOTAL (without liner)	$32.50

The material cost was derived by using a cost of $6.60/lb for 2.06 pounds per helmet. For any quantities of 30 tons or larger, the price would be somewhere between 5 and 6.60 dollars per pound. The per pound charge is applicable for quantities greater than 100,000 lbs, and assumes that the stock is in coiled form. This quantity requirement calls for a minimum of about 50,000 units/year.

To assure metal compatability with the titanium helmet, it is necessary to use titanium hinge loops. Therefore, the costs of the assembly will be higher than those used in the steel and nylon systems.

First destination transportation charges were based on the charge for the M-1 helmet. Since the dimensions of all the metal helmets are identical, the cubage for the same number of helmets would be the same. Therefore, the same freight charge is being used. This transportation is from the contractor's plant to a depot in CONUS.

Table 4

TITANIUM TYPE I HELMET
OPERATING COSTS AND FACTORS

O&M Renovation Cost Per Helmet		$1.40
Total Renovation Cost Per Year		75,600
DSA Handling	$.96/helmet	
Second Destination Transportation		.09/helmet
This cost is broken out as follows:		
Repair Dents Sand Helmet Paint	Labor Cost	.83
	Material	.57
		$1.40 per helmet

Total renovation cost is obtained by using a 4.11 per cent renovation of the total number of helmets currently in use, which yields a total of $75,600.

DSA handling cost was found by subtracting the cost of a helmet to a soldier in the field ($4.35) from production cost ($3.30). $4.35 - $3.30 = $1.05. Of this total, $.09 is second destination transportation cost per helmet, and $.96 is DSA handling.

III. TITANIUM - TYPE III

The suggested weight of the helmet is three (3) pounds. Like the steel helmet, the type III is designed as an outer shell and would require the use of a liner. The configuration of this helmet is identical with the type I titanium and M-1 steel helmets.

Table 5

TITANIUM TYPE III HELMET R&D COSTS

1.	Engineering	$17,600
2.	Tooling & Test Equipment	27,500
3.	Prototype Production	96,500
4.	Systems & Test Evaluation	15,000
5.	Data Handing & Documentation	5,000
	TOTAL	$161,600

These cost figures represent expended funds which are allotted through Applications Engineering funds for product improvement. The money was spent for research and development of the type III helmet.

It is interesting to note the great difference between R&D expenditures for the type I and type III helmets. The type III costs are about 4.3 times greater than type I costs. This large difference is attributed primarily to the fact that the superior ballistic test results of type III led NLABS to emphasize the development of a helmet that could logically replace the M-1 steel cover.

Table 6

TITANIUM TYPE III HELMET
INVESTMENT--NON-RECURRING COSTS

1.	Production Base Support	$ 75,000
2.	Advance Production Engineering	25,000
3.	Tooling & Test Equipment	45,000
4.	Other	20,000
	TOTAL	$165,000

One of the basic assumptions in this study is that the same equipment and tooling can be used in setting up a type I or a type III titanium helmet production line. However, possible contingent costs which may arise as a result of working a heavier titanium helmet (type III) are accounted

for by increasing the cost from $12,450 for type I titanium to $20,000 for type III.

Table 7

TITANIUM TYPE III HELMET
INVESTMENT--RECURRING COSTS

1. Helmet	
a. Direct material	$20.46
b. Chin strap (material)	.20
c. Hinge loop assembly (material and labor)	.25
d. Manufacturing labor costs	3.47
e. Manufacturing overhead @ 180.5% of direct labor costs	6.26
f. Reject rate	.52
g. G&A @ 19.5% of total (items a-f)	6.08
h. Profit @ 12.5% of total (items a-g)	4.66
2. First Destination Transportation	.02
TOTAL (without liner)	$41.92

The total necessary material weight was estimated to be 3.1 pounds. A $6.60/lb cost was assumed. The same pricing rationale of the type I helmet pertains to the type III. In

fact, all cost sources are the same for the type III recurring investment costs for the type I. The only perceptible cost change in the type III is for the material. Of course, the G&A and profit costs will change accordingly becuase of the increase in material costs.

Operation & Maintenance

The O&M cost breakout for the type I and type III titanium helmets is similar.

IV. LINCLOE NYLON

This helmet is part of the Lightweight Individual Combat Clothing and Equipment (LINCLOE) program. This helmet will weigh 1.5 pounds, and will be made of 7 ply nylon. There will be a removable suspension system, thereby precluding the use of a liner. A new chin strap will be used.

Table 8

LINCLOE NYLON HELMET R&D COSTS

1.	Engineering	$ 10,500
2.	Tooling & Test Equipment	61,000
3.	Prototype Production	64,500
4.	Systems Test & Evaluation	44,000
5.	Data Handing & Documentation	20,000
	TOTAL	$200,000

With the exception of 21 to 25 thousand dollars, all R&D funds have been obligated. This remainder is expected to be committed or obligated during FY 69.

The tooling and test equipment costs include one mold, $6,000, and the funds allotted for testing at NLABS, $15,000, and Edgewood Arsenal, $40,000. The total is $61,000.

The prototype production includes $500 for 110 helmets ($4.62 x 110) and $64,000 for a LINCLOE suspension system. The system was ultimately rejected for use in the helmet, but the money has been spent in conjunction with this system.

The weapon system test and evaluation cost breakdown includes $23,000 for ET/ST and $41,000 in AMC funds designated for USATECOM's testing of this particular system.

Data handling and documentation charges were estimated at $20,000. The engineering costs were the remainder of expended funds ($10,500).

Table 7

LINCLOE NYLON HELMET
INVESTMENT--NON-RECURRING COSTS

1.	Production Base Support	$226,000
2.	Advance Production Engineering	30,800
3.	Tooling and Test Equipment	9,200
4.	Other	25,000
	TOTAL	$291,000

Another assumption used in this study was that the set up costs of the LINCLOE nylon helmet would be largely the same

as those required to set up the present M-1 nylon liner production line. It was further assumed that the only conversion necessary would be the installation of two additional molds at $8,000 each. This cost increased the production base from $210,000 for the nylon liner to $226,000 for the LINCLOE nylon. All other costs remained unchanged.

Table 10

LINCLOE NYLON HELMET
INVESTMENT--RECURRING COSTS

1.	Helmet	
	a. Government furnished nylon	$4.774
	b. Other material (suspension system)	2.982
	c. Direct labor	.858
	d. Manufacturing overhead, G&A, and profit	4.068
	e. Scrap loss @ 4%	.413
	f. Freight in and out	.150
2.	First Destination Transportation	.02
	TOTAL	$13.27

The cost figures for the LINCLOE nylon helmet were derived as follows:

a. Receipt of an industry bid of $10.49/helmet based on 250,000 units per year.

b. Using the current nylon liner production schedule where:

Producer "X" makes 730,000 units

Producer "Y" makes 1,100,000 units

This provided a "Y" to "X" weight factor of 3/2.

c. Producer "X" charges $4.90/liner and producer "Y" charges $6.10/liner.

$4.90 is 80.32% of $6.10, which gives a factor of 119.6 % (100% - 80.32% + 100%)

Therefore 1.1968 x 10.49 = $12.554

d. Applying the weighting factor of 3/2 to $12.554 and $10.49, a cost of $11.72 for 250,000 units/year is reached.

e. Using a 95 per cent learning slope, the cost for 72,000 units/year is $13.25.

The individual costs were found by multiplying the weighted item cost by 113.05% ($\frac{\$13.25}{\$11.72}$) to find the average item costs at 72,000 units.

Manufacturing overhead, G&A, and profit percentages are lumped together to protect the rights of the manufacturer. However, these figures are the latest available.

If tools are to be contractor furnished, it will increase the end item piece price $.216 per unit, based on a three year write-off.

Table 11

LINCLOE NYLON HELMET
OPERATING COSTS AND FACTORS

O&M Renovation Cost Per Helmet	$2.09
Total Renovation Cost Per Year	112,860
DSA Handling	.67/helmet
Second Destination Transportation	.09/helmet

The average repair cost of a liner is given as $1.94. Based on a higher degree of involvement in the manufacturing process of the 7 ply LINCLOE nylon helmet over the 4 ply liner, a complexity of 1.076 was derived.[2]

An average of 54,000 liners are repaired yearly. This figure was also quoted for the LINCLOE nylon helmet. Therefore, the O&M cost for the LINCLOE helmet is found by the following procedure: $1.94 x 1.076 = $2.09.

[2] The ratio of production base support provided this factor as $2.26 \times 10^5 / 2.10 \times 10^5 = 1.076$.

The total O&M cost is readily found by: $2.09 x $54,000 = $112,860.

It is assumed that DSA handling cost for LINCLOE nylon helmets will be the same as the present DSA cost for the nylon liner, which is $0.07 for DSA handling and $.09 for second destination transportation.

V. HAYES-STEWART HELMET

This system is in the infancy stage of R&D. Final design has not yet been approved, nor has the final ballistic material been chosen.

The system we are estimating requires two separate molds--one for ventilation, and one for head protection. The design now being considered is dramatically different than today's steel cover. Because of these changes, the mold costs are expected to be higher. In addition, nine different head sizes rather than one average size will be used.

There will be an adjustable suspension system which will preclude using any liner. For the purposes of the initial estimate, 7 ply nylon will be considered the final ballistic material.

Table 12

HAYES-STEWART HELMET R&D COSTS

1.	Engineering	$ 85,000
2.	Tooling & Test Equipment	135,000
3.	Prototype Production	105,000
4.	Systems Test & Evaluation	20,000
5.	Data Handling & Documentation	---
	TOTAL	$345,000

The $85,000 engineering costs include $50,000 already allotted for in-house expenses, including the designing of the mold, ordering the material, and other tasks within the engineering area. The balance consists of the estimated charges for designing the nine molds if the R&D is continued.

The $135,000 for tooling and test equipment is estimated for the nine required molds, at an estimated cost of $15,000 per mold.

Prototype production costs have already been allotted to NLABS for 200 helmets.

The $20,000 for testing was to cover acceptance and compatibility tests conducted at Fort Benning, Ga. during August, 1968.

If initial tests prove acceptable, further R&D will be conducted. Therefore, the $170,000 mentioned above ($35,000 for engineering and $135,000 for tooling) has not yet been allotted to NLABS.

Table 13

HAYES-STEWART HELMET
INVESTMENT--NON-RECURRING COSTS

1.	Production Base Support	$276,000
2.	Advance Production Engineering	25,000
3.	Tooling & Test Equipment	15,000
4.	Other	16,500
		$332,500

At present, it is not known of what material the Hayes helmet will be made. However, prototypes and test models made to date have used 7 ply nylon. Thus, 7 ply nylon was used to estimate investment--non-recurring cost. Based on the increased complexity of the Hayes helmet, an increased cost of $50,000 over the LINCLOE nylon was included in the production base. This $50,000 differential was broken down thusly:

	Total Increases
1. 2 presses	$26,000
2. 4 molds	24,000
	$50,000

Therefore, for the production base cost, the total is:

$$\$226,000 + \$50,000 = \$276,000$$

The remaining costs are similar to the LINCLOE nylon cost categories based largely on engineering estimates and information relating differences in manufacturing processes.

Table 14

HAYES-STEWART HELMET
INVESTMENT--RECURRING COSTS

1.	Helmet	
	a. Government furnished nylon	$5.251
	b. Other material (suspension system)	2.982
	c. Direct labor	.944
	d. Manufacturing overhead, G&A, and profit	4.415
	e. Scrap loss @ 4%	.496
	f. Freight in and out	.150
	g. Direct labor and overhead for joining ventilation mold to helmet	1.416
2.	First Destination Transportation	.02
	TOTAL	$16.674

The Hayes-Stewart helmet costs were taken directly from the LINCLOE estimates. An additional 10 per cent for GF nylon and labor was added. The reject cost was increased by 20 per cent, since the configuration of the helmet is new and more complex. Freight costs were assumed to be identical. Manufacturing overhead, G&A and profit costs were combined in order to protect the manufacturer's proprietary interests.

Additional labor and overhead charges were added to cover the ventilation mold forming process.

If tools are to be contractor furnished, it will increase the end item piece price $.216 per unit, based on a three year write-off.

Table 15

HAYES-STEWART HELMET
OPERATING COSTS AND FACTORS

O&M Renovation Cost Per Helmet	$2.55
Total Renovation Cost Per Year	137,000
DSA Handling	.67/helmet
Second Destination Transportation	.09/helmet

The complexity factor for the Hayes helmet was found to be 1.314 (from production base support figures, $2.76 \times 10^5 / 2.10 \times 10^5 = 1.314$).

Making use of assumption 5 of this study, it is then reasonable to assume that the attrition rate on the Hayes and the LINCLOE nylon helmets will be similar. Therefore:

$1.94 x 1.314 = $2.55/helmet and

$2.55/helmet x 54,000 = $137,000

The second destination transportation costs are the same as those for the titanium helmets.

VI. LEARNING CURVE INFORMATION

Historical cost data were plotted for the M-1 steel helmet, and a learning curve "slope" of 95 per cent was derived. This rate of learning is also considered likely for other helmets being considered in this study. The point estimate used in conjunction with this learning rate is at the algebraic lot midpoint (25,480) of a production quantity of 72,000 helmets. The unit costs that are predicted in this study apply to first year production, and are used largely because of reasonable certainty that those costs will occur approximately one production year after set up. Therefore, the stipulated production rate of 6,000 x 12 mo. = 72,000.

This learning curve is applicable to single assembly lines only. If a new line is added, learning starts over.

First unit costs for the various systems are as follows: Type I--$70.00; Type III--$87.60; LINCLOE nylon--$28.33; and Hayes-Stewart--$36.50.

VII. GENERAL SUMMARY

Table 16 summarizes helmet costs at a production rate of 6000 units per month.

Table 16

LIFE CYCLE HELMET COST DATA

Cost Categories	M-1 ($)	HELMET TYPE TYPE I ($)	TYPE III ($)	LINCLOE NYLON ($)	HAYES-STEWART ($)
R&D		37,800	161,000	200,000	345,000
R&D sunk as of June, 1968		(37,000)	(161,000)	(177,000)	(175,000)
R&D requirement		000	000	28,000	170,000
INVESTMENT (Non-Recurring)		157,450	165,000	291,000	332,500
INVESTMENT (Recurring Unit Cost)	3.32	32.50	41.92	13.27	15.67
OPERATING & MAINTENANCE Unit Cost (LCC)	1.76	1.76	1.76	2.11	2.11

For a large annual production volume (500,000 units), the only dollar change would occur in Recurring Investment. The cost of the 500,000th unit would be $25.90 for the Type I; $33.90--Type III; $10.50--LINCLOE; and $13.00 for the Hayes-Stewart helmet.

The Initial Investment costs would also be the same, because all contractors who could presently manufacture either type of helmet have the capacity to produce 500,000 units per year.

The O&M costs are given in per unit figures. The maintenance operations performed are quite basic; consequently, almost negligible learning is involved. Therefore, the O&M per unit cost is valid as presented.

VIII. SUMMARY WORKSHEET

	CURRENT M-1 HADFIELD STEEL	TYPE I TITANIUM	TYPE III TITANIUM	LINCOLN NYLON	HAYES HELMET (assuming 7 ply nylon)	NYLON LINER (CURRENTLY IN SYSTEM)
I DEVELOPMENT						
A. RDTE						
1) Engineering		6,300.00	17,600.00	10,500.00	85,000.00	
2) Tooling & Test Equipment		4,500.00	27,500.00	61,000.00	135,000.00	
3) Prototype Production		20,500.00	96,500.00	64,500.00	105,000.00	
4) Systems Test & Evaluation		4,000.00	15,000.00	44,000.00	20,000.00	
5) Data Handling & Documentation		2,500.00	5,000.00	20,000.00	---	
6) Other		---	---	---	---	
TOTAL		37,800.00	16[illegible],600.00	200,000.00	345,000.00	
II INVESTMENT						
A. Non-Recurring	(1)	(2)	(3)	(4)	(5)	(6)
*1) Production Base Support	46,330.00	75,000.00	75,000.00	226,000.00	276,000.00	210,000.00
2) Advance Production Engineering	5,170.00	25,000.00	25,000.00	30,800.00	25,000.00	30,800.00
3) Tooling & Test Equipment	15,000.00	45,000.00	45,000.00	9,200.00	15,000.00	9,200.00
4) Other	8,300.00	12,450.00	20,000.00	25,000.00	16,500.00	25,000.00
TOTAL	74,800.00	157,450.00	165,000.00	291,000.00	332,500.00	275,000.00
B. Recurring		Average Unit Cost 72,000 units 1st yr				
1) Helmet						
a) Direct material		13.60	20.46	4.774 a)	5.251 a)	
b) Chin strap (material)		.20	.20	2.982 b)	2.982 b)	
c) Hinge loop assembly (material and labor)		.25	.25	.858 c)	.944 c)	
d) Manufacturing (direct labor and some material)		3.47	3.47	4.068 d)	4.415 d)	
e) Manufacturing overhead @ 180.5%		6.26	6.26	.413 e)	.496 e)	
f) Scrap loss		.38	.52	.150 f)	.150 f)	
g) G & A @ 19.5%		4.71	6.08		1.416 g)	
h) Profit @ 12.5%		3.61	4.66			
i) Freight & losses		NA	NA			
TOTAL	3.30	32.48	41.90	13.245	16.654	
2) First Destination Transportation	.02	.02	.02	.02	.02	
TOTAL	3.32	32.50	41.92	13.27	16.67	
3) Liner	7.15	7.15	7.15	NA		
TOTAL COST (with liner)	11.50	39.69	49.07	13.27		
III OPERATING & MAINTENANCE						
1) Renovation cost per helmet	1.40					
2) Total renovation cost per year		1.40	1.40	2.09	2.55	
3) DSA Handling	.96	75,000.00	75,000.00		137,000.00	
4) Second Destination Transportation	.09	.96	.96	.67	.67	
		.09	.09	.09	.09	

*Does not include cost of land rental, buildings, and utility systems.
(1), (2), (3), (4), (5), (6), PROD. RATE = 6,000 UNITS/MO.

a) Government furnished nylon
b) Other material (suspension system)
c) Direct labor
d) Manufacturing overhead, G&A & profit
e) Scrap loss @ 4%
f) Freight in and out
g) Direct labor & overhead for joining ventilation mold to helmet

[illegible] 17 [illegible] 24 [illegible]

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D *Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)*	
1 ORIGINATING ACTIVITY *(Corporate author)* Headquarters, US Army Materiel Command Washington, D.C. 20315	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP N/A
3 REPORT TITLE HELMET STUDY COST ANALYSIS REPORT	
4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*	
5 AUTHOR(S) *(First name, middle initial, last name)* Gordon A. Finch Frank C. Schroeder, III	
6 REPORT DATE December 1968	7a. TOTAL NO OF PAGES 32 / 7b NO OF REFS
8a CONTRACT OR GRANT NO b PROJECT NO c d	9a ORIGINATOR'S REPORT NUMBER(S) Technical Report 68-9 9b OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
10 DISTRIBUTION STATEMENT Distribution of this document is unlimited	
11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY

13 ABSTRACT

This study provides life cycle cost data on these US Army infantry-type helmets: (1) Titanium Type I; (2) Titanium Type III; (3) LINCLOE nylon; and (4) Hayes-Stewart. These data include research and development, production, and operating costs. A 95 per cent learning (experience) curve gradient is appropriate for helmet production.

DD FORM 1 NOV 1473 REPLACES DD FORM 1 JAN 64 WHICH IS OBSOLETE FOR ARMY USE

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Helmet						
Characteristics						
Development costs						
Investment costs						
Operating costs						
Titanium						
LINCLOE nylon						
Hayes-Stewart						